

57. (New) The method of claim 56 wherein the reactant stream has a cross section perpendicular to the propagation direction characterized by a major axis and a minor axis, the major axis being at least about a factor of two greater than the minor axis.
58. (New) The method of claim 56 wherein the reactant stream comprises a silicon precursor.
59. (New) The method of claim 56 wherein the substrate is moved relative to the product stream while directing the stream of particles to the substrate.
60. (New) The method of claim 56 wherein the directing of the product stream to the substrate deposits at least about 25 grams per hour onto the substrate.
61. (New) The method of claim 56 wherein the substrate does not permit gas to pass through.

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REMARKS

Claims 18-61 are pending. By this Amendment, claims 1-17 are canceled, and claims 18 and 39 are amended. New claims 43-61 are added. The specification is amended to update references to copending applications. In addition, the specification is amended in the paragraph at page 5, lines 18-28 to place in the body of the specification features from claims 34 and 36, as filed.

Applicants have amended claims 18 and 39 for clarity. Applicants do not believe that the scope of claim 18 is changed by the amendment from its inherent scope as filed. The amendment of claim 18 is supported by the specification, for example, at page 9, lines 26-34 and page 21, line 3 to page 23, line 17. The amendment of claim 39 is supported by the specification, for example, at page 9, lines 26-34, page 10, lines 15-25 and page 22, lines 1-8.

New claims 43-46, 52 and 58 are supported by the specification, for example, at page 25, lines 8-23. New claim 47 is supported by the specification, for example, at page 29,

lines 14-17. New claims 48 and 59 are supported by the specification for example at page 15, lines 20-31. New claim 49 is supported by the specification, for example, at page 15, lines 2-4, page 45, lines 3-5, page 47, lines 27-29, page 64, lines 22-24 and Figures 19 and 22. New claim 50 is supported by the specification, for example, claim 34 as filed. New claims 51 and 56 are supported by the specification, for example, at page 21, lines 4-6 and page 25, lines 2-7. New claims 53 and 54 are supported by the specification, for example, at page 63, line 31 to page 64, line 4. New claim 55 is supported by the specification, for example, at page 6, lines 1-3, page 9, lines 26-29 and page 10, lines 13-18. New claim 57 is supported by the specification, for example at page 5, lines 24-28. New claim 60 is supported, for example, by claim 34 as filed. New claim 61 is supported by the specification, for example, at page 10, lines 23-34. No new matter is introduced by the amendments or by the new claims.

Claims 18-42 stand rejected. Applicants respectfully request reconsideration of the rejections based on the following remarks.

#### Election/Restriction

The Examiner imposed an election/restriction requirement between two asserted inventions. Applicants affirm their election by telephone of group I claims 18-42 without traverse. Applicants have canceled claims 1-17 corresponding to the non-elected invention.

#### Rejection Under 35 U.S.C. §102

The Examiner rejected claims 18 and 29 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 6,280,802 to Akedo et al. (the Akedo patent). The Examiner noted that the Akedo patent discloses accelerating ultrafine particles and colliding them with the substrate in order to apply a thin film of the particles. The Examiner further asserted that an activation process involving a radiation step is a type of reaction. Applicants do not believe that

the Akedo reference established prima facie anticipation of Applicants' claims. Applicants have amended claim 18 to clarify the scope of the claim. Applicants respectfully request reconsideration of the rejection based on the following comments.

Applicants have amended claim 18 to clarify that the particles are produced by the reaction. The activation process of the Akedo patent does not describe the production of particles. Since the Akedo patent does not disclose the in situ production of particles, the Akedo patent does not disclose all of the elements of Applicants' claimed invention and fails to establish a prima facie case of anticipation. Applicants respectfully request withdrawal of the rejection of claims 18 and 29 under 35 U.S.C. §102(e) as being anticipated by the Akedo patent.

Rejections Over Akedo et al. and Bi et al.

The Examiner rejected claims 18-29 under 35 U.S.C. §103(a) as being unpatentable over the Akedo patent in view of U.S. Patent 5,958,348 to Bi et al. (the Bi patent). The Examiner noted that the Akedo patent discloses directing a particle stream at a substrate to deposit particles. The Examiner further noted that the Bi patent discloses an apparatus for the production of nanoscale particles using a radiation beam. The Examiner asserts that it would be obvious to use the particle production apparatus of the Bi patent as a replacement of the aerosolizing chamber of the Akedo patent. Applicants respectfully assert that the references do not motivate their combination in the way suggested by the Examiner and that the combination does not lead to Applicants' claimed invention. Applicants further assert that the combined disclosures of the references do not render Applicants' claims prima facie obvious. Applicants respectfully request reconsideration of the rejections based on the above and following comments.

The references do not provide any motivation for their combination in the manner suggested in the Office Action. The Akedo patent focuses exclusively on improved approaches

for depositing particles from a particle supply in an aerosolizing chamber or the like. The Akedo patent does not teach, suggest or motivate producing the particles in situ for the deposition process. Similarly, the Bi patent discusses the production and harvesting of particles in a collector. The Bi patent does not teach, suggest or motivate the direct coating of the particles produced in the reactor.

The Examiner suggests that the motivation to combine the references is found in the teaching of the Bi patent of the efficient use of resources at high production capacity without sacrificing particle quality. However, these advantages would be obtained by using the Bi reactor to **produce and collect** the particles and **transferring** the collected particles to the **aerosolizing chamber** of the Akedo patent, as taught by the respective patents. The Examiner has not noted any motivation in the references for substituting the production apparatus directly for the aerosolizing chamber.

↙ not applicable in line?

In addition, the references do not provide a reasonable expectation of success. Since the Akedo patent focuses exclusively on the improved deposition of particles, the Akedo does not provide any indication of how the conditions used for the deposition of particles from the aerosolizing chamber would or could be modified if the particles were produced in situ. Similarly, the Bi patent describes the conditions appropriate for the production and collection of particles. There is no discussion of modification that would be appropriate for the coating of the particles onto a substrate. Due to the gaps in the respective disclosures, there would be no reasonable expectation of success in combining the disclosures as suggested by the Examiner.

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Since the references do not teach suggest or motivate their combination as suggested by the Examiner, since the combination of the teachings of the references does not lead to the claimed invention and since the references do not result in a reasonable expectation of success, the combined disclosures of the references do not render Applicants' claimed invention obvious. Applicants respectfully request the withdrawal of the rejection of claims 18-29 under

35 U.S.C. §103(a) as being unpatentable over the Akedo patent in view of the Bi patent. Because of these deficiencies in the references such that they do not render the present claims obvious, Applicants have not examined and do not comment here on the remaining issues pertaining to the features of the dependent claims.

Rejections Over Akedo et al. under 35 U.S.C. §103(a)

The Examiner rejected claims 21, 23, 25, 27 and 28 under 35 U.S.C. §103(a) as being unpatentable over the Akedo patent. The Examiner asserted that the features of the independent claim 18 were disclosed in the Akedo patent. The Examiner asserted that the features described in the listed dependent claims were obvious to a person of skill in the art based on the Akedo reference and knowledge in the art. However, the Akedo patent does not render the claims prima facie obvious since it does not teach, suggest or motivate feature(s) of the claimed invention. Applicants respectfully request reconsideration of the rejections based on the following comments.

As noted above, the Akedo patent does not disclose, teach or suggest producing particles in situ. Applicants' claims relate to the production of particles in situ and their deposition. Since the Akedo patent does not teach, suggest or motivate a claimed feature(s) of Applicants' invention, the Akedo patent does not render Applicants' claims prima facie obvious. Since the Akedo reference is deficient with respect to a basic feature of independent claim 18, the particular features of the dependent claims are not relevant to patentability and are not discussed further with respect to their relevance for patentability.

Applicants respectfully request withdrawal of the rejection of claims 21, 23, 25, 27 and 28 under 35 U.S.C. §103(a) as being unpatentable over the Akedo patent.

Rejections of Claim 30

The Examiner rejected claim 30 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,097,144 to Lehman (the Lehman patent) in view of the Akedo patent and the Bi patent and further in view of PCT application WO 99/23189 to Kambe et al. (the Kambe application). The Examiner further rejected claim 30 under 35 U.S.C. §103(a) as being unpatentable over the Lehman patent in view of the Akedo patent. It is unclear to Applicants why these rejections are not duplicative, and they are discussed together. The Examiner cited the Lehman patent for disclosing the production of a glass coating from a frit. The Examiner cited the Bi patent for disclosing nanoparticles with exploitable chemical and mechanical properties. The Examiner suggests the combination of the Akedo patent and the Bi patent, as described above, for the proposition of substituting the Bi apparatus for the aerosolizing chamber of the Akedo patent. The Examiner cited the Kambe application for disclosing the production of silicon oxide nanoparticles using an apparatus similar to the Bi apparatus. Applicants believe that the combination suggested by the Examiner is based on hindsight using Applicants' present specification and that the combined disclosures of the references do not render Applicants' claimed invention prima facie obvious. Applicants respectfully request reconsideration of the rejection of claim 30 based on the above and following comments.

As described in detail above, the combined disclosures of the Akedo patent and the Bi patent do not render Applicants' claims obvious since they do not teach, suggest or motivate the substitution of the Bi apparatus for the aerosolizing chamber of the Akedo patent and since they do not provide a reasonable expectation of success. The teachings of the Lehman patent and the Kambe patent do not make up for the deficiencies of the Akedo patent and the Bi patent with respect to rendering obvious Applicants' claimed invention.

The Lehman patent like the Akedo patent describes the formation of a coating from a powder of particles with a desired composition. The Lehman patent specifically

describes mixing the particles with a solvent carrier to disperse the particles for deposition. See, for example, column 5, lines 55-60. The mixing of the particles with a solvent carrier for delivery of the particles seems inconsistent with in situ production of the particles and subsequent deposition from a flow. Thus, the Lehman patent actually teaches away from the present invention.

The Kambe patent, like the Bi patent, describes the production and collection of particles. The Kambe patent does not teach, suggest or motivate the deposition of the particles from the flow as a coating. The combination of the Kambe patent and the Akedo patent does not lead to Applicants' claimed invention for the same reasons that the combination of the Akedo patent and the Bi patent does not lead to Applicants' claimed invention.

Since none of the references teach, suggest or motivate the in situ product of particles in a flow and the coating of the particles from the flow onto a substrate, the cited references alone or together do not lead to Applicants' claimed invention absent hindsight based on Applicants' specification. Therefore, the combined disclosures of the references do not render the claims prima facie obvious.

Applicants respectfully request withdrawal of the rejection of claim 30 both under 35 U.S.C. §103(a) as being unpatentable over the Lehman patent in view of the Akedo patent and the Bi patent and further in view of the Kambe application and under 35 U.S.C. §103(a) as being unpatentable over the Lehman patent in view of the Akedo patent.

#### Rejections Of Claims 31 and 32

The Examiner rejected claims 31 and 32 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,074,888 to Tran et al. (the Tran patent) in view of the Lehman patent and further in view of the Akedo patent and the Bi patent in view of the Kambe application. The Examiner further rejected claims 31 and 32 under 35 U.S.C. §103(a) as being

unpatentable over the Tran patent in view of the Lehman patent and the Akedo patent. It is unclear to Applicants why these rejections are not duplicative, and they are discussed together. The Examiner cited the Tran patent for disclosing the processing of an optical layer to form an optical material. The Examiner noted that the Tran patent "fails to give details of the optical layer." The Examiner cites the remaining references for disclosing the formation of an advantageous glass coating. However, as discussed in detail above, the Lehman patent, the Akedo patent, the Bi patent and the Kambe application, alone or combined, do not teach, suggest or motivate Applicants' claimed method of coating formation. The combined disclosures of the cited references do not establish the prima facie obviousness of Applicants' claimed invention. Applicants respectfully request reconsideration of the rejections based on the above and the following comments.

As described above, the Lehman patent, the Akedo patent, the Bi patent and the Kambe application do not teach, suggest or motivate producing particles in situ and depositing the particles from a flow onto a substrate. The Tran patent does not describe particle coatings. Therefore, the Tran patent does not make up for the deficiencies of the other references. Since the references alone or together do not teach, suggest or motivate a claimed feature of Applicants' invention, the combined disclosures of the five cited references do not establish prima facie obviousness of Applicants' claimed invention. Applicants respectfully request withdrawal of the rejection of claims 31 and 32 under 35 U.S.C. §103(a) as being unpatentable over the Tran patent in view of the Lehman patent and further in view of the Akedo patent and the Bi patent in view of the Kambe application.

#### Rejections Of Claims 33-38

The Examiner rejected claims 33-38 under 35 U.S.C. §103(a) as being unpatentable over the Akedo patent in view of the Bi patent. The Examiner cited the Bi patent



for disclosing a process with a reactant stream with a cross section perpendicular to the propagation direction characterized by a major and minor axis. The Examiner cited the Akedo patent for disclosing the use of an electric field to accelerate particles onto a substrate. There is no motivation in the references to combine them as suggested by the Examiner, and the combination of the references does not lead to Applicants' claimed invention. Therefore, the references do not establish prima facie obviousness of Applicants' claimed invention. Applicants respectfully request reconsideration of the rejections based on the following comments.

The Bi patent discloses the production and collection of particles. The particle collector separates the particles from the flow by filtering the flow on the way to a pump. The Bi patent does not teach, suggest or motivate the coating onto a substrate. On the other hand, the Akedo patent does not teach, suggest or motivate the production of particle in situ along with the particle deposition. The Akedo patent completely focuses on the manipulation of particles from an aerosol chamber or the like to deposit the particles in a controlled way on a substrate as a coating. There is no motivation in the references to combine the references as suggested by the Examiner without hindsight based on Applicants' own disclosure.

If the references are combined, the apparent way to combine the teachings is to produce the particles with the Bi apparatuses, harvest the particles from the collector and place the particles into the aerosol chamber of the Akedo apparatus. The reference references do not motivate the substitution of the Bi reaction chamber for the aerosol chamber of the Akedo patent. The Examiner states that "As the filter and the substrate both are designed to collect the nanoparticles, it would be obvious to have a coating chamber of the same type in place of, or prior to, the filter chamber." However, this statement must be based on hindsight since the references do not teach this. The filter is used to collect particles for **harvesting**. The Bi patent contrasts nanoscale particles with other **powders**. See, for example, column 1, lines 18-25.

However, in forming a coated substrate, the coating can be intended to remain on the substrate and not harvested from the substrate.

Due to these clear deficiencies in the teaching of the references with respect to independent claim 33, we do not consider further here the features of the dependent claims. Since the references do not teach, suggest or motivate the formation of a coating onto a substrate with particles produced in situ, the combined teachings of the references do not establish prima facie obviousness. Applicants respectfully request withdrawal of the rejection of claims 33-38 under 35 U.S.C. §103(a) as being unpatentable over the Akedo patent in view of the Bi patent.

#### Rejection Of Claims 39-42

The Examiner rejected claims 39-42 under 35 U.S.C. §103(a) as being unpatentable over either the Akedo patent alone or over the Akedo patent in view of the Bi patent. Applicants believe that there may be some misunderstandings with respect to the scope of these claims. Claim 39 has been amended to clarify the scope of this claim. Applicants assert that the combined disclosures of the references do not teach, suggest or motivate the coating of particles produced in situ. Therefore, the references do not render the claims prima facie obvious. Applicants respectfully request reconsideration of the rejections based on the following comments.

With respect to the rejections over the Akedo patent alone, the Akedo patent does not teach, suggest or motivate the production of particles in situ. Therefore, the Akedo patent does not render claims 39-42 prima facie obvious. The other features of the claims are not necessary to impart patentability of the claims over the Akedo patent.

With respect to the rejections over the combination of the Akedo patent and the Bi patent, it has been discussed in great detail that these references do not teach, suggest or motivate a combination involving a process that generates the particles in situ and coats the particles from

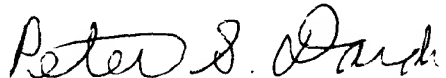
a flow of the product particles onto a substrate. Since these fundamental features of the claimed invention do not follow from the references, the other features of the claims do not need to be discussed. The combined disclosures of the Akedo patent and the Bi patent do not render the claimed invention prima facie obvious. Applicants respectfully request withdrawal of the rejection of claims 39-42 under 35 U.S.C. §103(a) as being unpatentable over either the Akedo patent alone or over the Akedo patent in view of the Bi patent.

### CONCLUSIONS

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,



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Peter S. Dardi  
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ATTACHMENT  
MARKED-UP AMENDMENTS

Specification As Amended

At page 5, lines 18-28, the paragraph has been amended as follows:

In another aspect, the invention pertains to a method of coating a substrate comprising generating a reactant stream, reacting the reactant stream to form a product stream of particles, and directing the stream of particles to a substrate, wherein flow of the product stream is maintained other than by pumping on the substrate. In preferred embodiments, the reactant stream has a cross section perpendicular to the propagation direction characterized by a major axis and a minor axis, the major axis being at least a factor of two greater than the minor axis. In further embodiments, the major axis is at least a factor of ten greater than the minor axis. In some embodiments, at least about 25 grams per hour of particles are deposited onto the substrate.

At page 26, line 25 to page 27, line 3, the paragraph has been amended as follows:

The use of exclusively gas phase reactants is somewhat limiting with respect to the types of precursor compounds that can be used conveniently. Thus, techniques can be used to introduce aerosols containing reactant precursors to the reaction zone. Improved aerosol delivery apparatuses for laser pyrolysis reaction systems are described further in commonly assigned and copending U.S. Patent Application Serial Number 09/188,670, now U.S. Patent 6,193,936 to Gardner et al., entitled "Reactant Delivery Apparatuses," filed November 9, 1998, incorporated herein by reference. These aerosol delivery apparatuses can be adapted for performing light reactive deposition.

At page 38, line 22 to page 39, line 2, the paragraph has been amended as follows:

In one preferred embodiment of a high capacity particle production apparatus, the reaction chamber and reactant inlet are elongated significantly along the light beam to provide for an increase in the throughput of reactants and products. The embodiments described above for the delivery of gaseous reactants and aerosol reactants can be adapted for the elongated reaction chamber design. Additional embodiments for the introduction of an aerosol with one or more aerosol generators into an elongated reaction chamber is described in commonly assigned and copending U.S. Patent application serial No. 09/188,670, now U.S. Patent 6,193,936 to Gardner et al., entitled "Reactant Delivery Apparatuses," incorporated herein by reference.

At page 54, lines 24-34, the paragraph has been amended as follows:

In addition, tin oxide nanoparticles have been produced by laser pyrolysis, as described in copending and commonly assigned U.S. Patent Application Serial No. 09/042,227, now U.S. Patent 6,200,674 to Kumar et al., entitled "Tin Oxide Particles," incorporated herein by reference. The production of zinc oxide nanoparticles is described in copending and commonly assigned U.S. Patent Application Serial Number 09/266,202 to Reitz, entitled "Zinc Oxide Particles," incorporated herein by reference. In particular, the production of ZnO nanoparticles is described.

#### Claims As Amended

Claims 1-17 have been canceled without prejudice or disclaimer.

Claims 18 and 39 have been amended as follows:

18. (Amended) A method of coating a substrate, the method comprising:

reacting a reactant stream by directing a focused radiation beam at the reactant stream to produce a product stream comprising particles downstream from the radiation beam, wherein the particles are produced by the reaction and wherein the reaction is driven by energy from the radiation beam;  
directing the product stream to a substrate; and  
moving the substrate relative to the product stream to coat the substrate.

39. (Amended) A method of coating a substrate having a diameter greater than about 5 cm, the method comprising:

reacting a reactant stream to form a product stream comprising product particles, wherein the particles are produced by the reaction; and

depositing simultaneously a stream of particles over the entire surface of the substrate and wherein at least about 5 grams per hour of particles are deposited onto the substrate.

New claims 43-61 have been added as follows:

43. (New) The method of claim 18 wherein the reactant stream comprises a silicon precursor.

44. (New) The method of claim 18 wherein the reactant stream comprises a metal precursor.

45. (New) The method of claim 33 wherein the reactant stream comprises a silicon precursor.

46. (New) The method of claim 33 wherein the reactant stream comprises a metal precursor.

47. (New) The method of claim 35 wherein the light beam comprises infrared light.

48. (New) The method of claim 33 wherein the substrate is moved relative to the product stream while directing the stream of particles to the substrate to coat different portions of the substrate.
49. (New) The method of claim 33 wherein the substrate is moved relative to the product stream while directing the stream of particles to the substrate to coat the surface of the substrate in one pass of the substrate through the product stream.
50. (New) The method of claim 39 wherein at least about 25 grams per hour are deposited onto the substrate.
51. (New) The method of claim 39 wherein the reaction is driven by energy from a radiation beam.
52. (New) The method of claim 39 wherein the reactant stream comprises a silicon precursor.
53. (New) The method of claim 42 wherein at least two of the multiple product streams comprise product particles with the same composition.
54. (New) The method of claim 42 wherein at least one of the multiple product streams comprise product particles with a different composition from product particle in another of the multiple product streams.
55. (New) A method of coating a surface of a substrate, the method comprising:  
reacting a reactant stream to product a product stream comprising particles wherein the particles are produced by the reaction; and  
directing the product stream to the substrate to deposit at least about 5 grams per hour onto the substrate.
56. (New) The method of claim 56 wherein the reaction is driven by energy from a radiation beam.

57. (New) The method of claim 56 wherein the reactant stream has a cross section perpendicular to the propagation direction characterized by a major axis and a minor axis, the major axis being at least about a factor of two greater than the minor axis.
58. (New) The method of claim 56 wherein the reactant stream comprises a silicon precursor.
59. (New) The method of claim 56 wherein the substrate is moved relative to the product stream while directing the stream of particles to the substrate.
60. (New) The method of claim 56 wherein the directing of the product stream to the substrate deposits at least about 25 grams per hour onto the substrate.
61. (New) The method of claim 56 wherein the substrate does not permit gas to pass through.